

Herpetofauna in the Kaluganga upper catchment of the Knuckles Forest Reserve, Sri Lanka

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Abstract.—The Knuckles Forest Reserve and forest range is a paradise for a large number of endemic Sri Lankan taxa, including a considerable number of amphibian and reptile species. A survey carried out on the western slopes of the Kaluganga catchment of Knuckles Forest Reserve recorded 19 species of amphibians and 30 species of reptiles. Of these, 15 species of amphibians and 17 species of reptiles are endemic to Sri Lanka, and 11 species are restricted to a few localities in the Knuckles forest range. Three unidentified species possibly new to science were discovered in the study, and we recommend that these species need further study for taxonomic identification.

Key words. Knuckles forest reserve, herpetofauna, endemic, restricted, threatened, Sri Lanka

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Introduction

The Knuckles mountain range of Sri Lanka is a distinct topographic feature of the central highlands of Sri Lanka, covering approximately 21,000 ha. It lies between latitudes 7°18'–7°34' N and longitudes 80°41'–80°55' E at 900–1900 m elevation range. This landscape is made unique by the aggregation of at least 35 spectacular peaks rising above 900 m in the Kandy and Matale Districts. The Knuckles range is geologically part of the central highlands of the island but isolated from the main mountain mass by the Mahaweli River valley on the south and east and on the west by the Matale valley (De Rosayro 1958). The Knuckles range is one of the more important watersheds in the country. It receives rainfall from both the southwest and northeast monsoons. Numerous tributaries of the Knuckles contribute to major rivers, including the Mahaweli. The area's mean annual temperature outside the massif is more than 26 °C, and this value falls to about 21 °C at elevations above 915 m and to about 18.5 °C at the highest elevations (Cooray 1998).

The topographic and climatic variation in the Knuckles region has resulted in the occurrence of several natural vegetation types. According to Rosayro (1958), vegetation types of the Knuckles region are categorized as lowland tropical wet semi-evergreen forests, sub-montane tropical wet semi-evergreen forests, and montane tropical wet evergreen forests. Gunatilleke and Gunatilleke (1990) recognized 15 floristic regions in Sri Lanka, and each of these has dominant plant communi-

ties. The Knuckles forest belongs to the 12th floristic region (termed Knuckles) with a unique vegetation type. According to these authors, there are two types of natural vegetation in this region: tropical montane forests characterized by a *Calophyllum* zone and tropical sub-montane forests characterized by a *Myristica*, *Cullenia*, *Aglaia*, and *Litsea* community (Karunarathna et al. 2009).

In addition to these categories, there are anthropogenic vegetation types such as patana grasslands, which are dominated by *Cymbopogon* spp. derived from abandoned coffee and tea plantations, scrublands, and agricultural land.

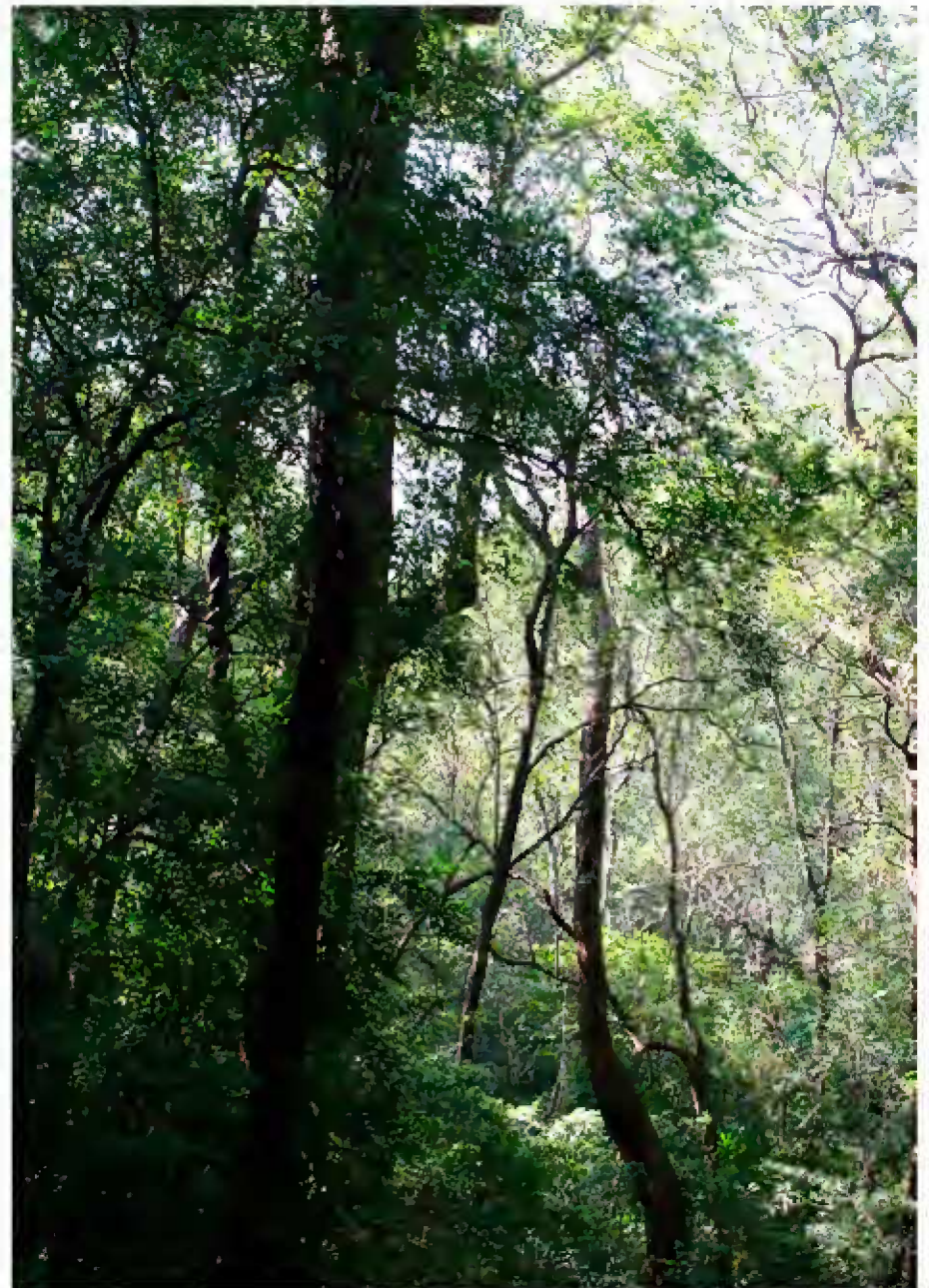
The geographic location, altitude, and position of the mountain range in relation to the two main wind currents that cross the island have resulted in a unique ecosystem with an abundance of endemic flora and fauna (Kariyawasam 1991). The variety of habitats and forest communities in the Knuckles is known to harbor a diverse community of herpetofauna, but a large extent of the mountain range remains unexplored. In an effort to identify and study the distribution of amphibians and reptiles, a study was carried out in the tropical montane forests, sub-montane forests, and lowland semi-evergreen forests of the under-researched Kaluganga catchment of the Knuckles range. These forest types were derived based on elevational range (Bambaradeniya and Ekanayake 2003):

- Tropical Montane Forest (>1300 m a.s.l.)
- Tropical Sub-montane Forest (600–1300 m a.s.l.)
- Lowland Semi-evergreen Forest (below 700 m a.s.l.)

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Tropical Sub-montane Forest (600-1300 m a.s.l.).



Lowland Semi-evergreen Forest (below 700 m a.s.l.).



Tropical Montane Forest (>1300 m a.s.l.).

Methods

Fieldwork was conducted from May to July 2010 in the Kaluganga upper catchment of Knuckles range. The study area extended from the Pallegama main bridge to Kalupahana mountain area. In each habitat, data were collected from five 100×10 m transects, with one night sampling per habitat. The distance between transects was more than 500 m. Within each major habitat, different microhabitats (such as tree trunks, tree holes, water puddles, and other small niches) were systematically searched for herpetofauna. Three people were involved

in the sampling of each transect. One person searched above 1.5 m on trees for arboreal species, while a second person pursued a terrestrial search under logs, stones, leaf litter, tree trunks, etc., and a third person searched aquatic habitats (puddles and streams). In addition to recording the different species within each transect, a thorough search for different amphibians and reptiles was carried out along nature trails or footpaths and streams outside of the five transects. The different species of amphibians and reptiles were hand-captured or collected using a hand net and observed. Frog species were located using their call signatures. Taxonomic keys (Manamendra-Arachchi and Pethiyagoda 2006; Dutta and Manamendra-Arachchi 1996; De Silva 1980; Deraniyagala 1953; Somaweera 2006; Taylor 1953) were used for identification or confirmation of collected species. Photographs of live specimens were taken in the field using a Canon EOS 350 SLR camera. After identification, the animals were released to their natural habitat unharmed.

Results and discussion

A total of 49 species of amphibians and reptiles were identified from the study sites. The survey documented 19 species of amphibians belonging to the families Bufonidae, Dicroglossidae, Nyctibatrachidae, Ranidae, and

Table 1. List of amphibians recorded during the study period from the Kaluganga upper catchment in the Knuckles (Abbreviations: * - Endemic to Sri Lanka; /R - restricted to the Knuckles forest region; CR - Critically Endangered; and EN – Endangered).

Family	Scientific name	Common name
Bufonidae	<i>Adenomus kelaartii</i> *	Kelaart’s dwarf toad
	<i>Duttaphrynus melanostictus</i>	Common house toad
Dicroglossidae	<i>Euphlyctis cyanophlyctis</i>	Skipper frog
	<i>Fejervarya kirtisinghei</i> *	Mountain paddy field frog
	<i>Fejervarya limnocharis</i>	Common paddy field frog
	<i>Nannophrys marmorata</i> *,/R, CR	Kirtisinghe’s rock frog
Nyctibatrachidae	<i>Lankanectes</i> cf. <i>corrugatus</i> *	Corrugated water frog
Ranidae	<i>Hylarana temporalis</i>	Common wood frog
	<i>Hylarana gracilis</i> *	Sri Lanka wood frog
Rhacophoridae	<i>Pseudophilautus fergusonianus</i> *	Ferguson’s tree frog
	<i>Pseudophilautus fulvus</i> *,/R, EN	Knuckles shrub frog
	<i>Pseudophilautus hoffmanni</i> *,/R, EN	Hoffmann’s shrub frog
	<i>Pseudophilautus hankeni</i> *,/R	Hanken’s shrub frog
	<i>Pseudophilautus stuarti</i> *,/R, EN	Stuart’s shrub frog
	<i>Pseudophilautus steineri</i> *,/R, EN	Steiner’s shrub frog
	<i>Pseudophilautus macropus</i> *,/R, CR	Bigfoot shrub frog
	<i>Pseudophilautus cavirostris</i> *, EN	Tubercle tree frog
	<i>Polypedates cruciger</i> *	Common hour-glass tree frog
	<i>Taruga</i> cf. <i>eques</i> *, EN	Mountain hourglass tree frog

Rhacophoridae (15 of these species are endemic to the island; Table 1). In addition, three unidentified species of amphibians were collected; further studies are being carried out for taxonomic identification of these three species, and they may or may not be new to science. Further studies are also being carried out to identify the distribution and ecology of *Taruga eques* and *Lankanectes* cf. *corrugatus* in the region.

Among the identified species, there are seven regionally endemic species restricted to the Knuckles range, including three Critically Endangered species (*Pseudophilautus hankeni*, *P. macropus*, and *Nannophrys marmorata*) and six Endangered species (*P. fulvus*, *P. hoffmanni*, *P. stuarti*, *P. steineri*, *P. cavirostris*, and *Taruga eques*).

In this study, a total of 30 species of reptiles were recorded, with 17 regionally endemic species including four species restricted to Knuckles (Table 2). Among

these, two species are Critically Endangered (*Cophotis dumbara* and *Chalcidoseps thwaitesi*) and four species are Endangered (*Calotes liocephalus*, *Ceratophora tennentii*, *Cyrtodactylus soba*, and *Lankascincus deraniyagalae*) (IUCN-SL and MENR-SL 2007).

Brief description of natural history and distribution of key species encountered during survey

Adenomus kelaartii

Endemic species to the island and found in lowland semi-evergreen forests of Knuckles forest range, primarily in riverine forests and wet patana grasslands. Species commonly observed on leaf litter and rarely recorded in semi-arboreal habitats 1.5 m above ground. Species recorded from Rambukoluwa and Manigala patana area.



Adenomus kelaartii.



Nannophrys marmorata.

Table 2. Reptiles recorded during study period from Kaluganga upper catchment Knuckles range (Abbreviations: Endemic to Sri Lanka; /R - restricted to the Knuckles forest region; CR - Critically Endangered; and EN – Endangered).

Family	Scientific name	Common name
Agamidae	<i>Calotes calotes</i>	Green garden lizard
	<i>Calotes liolepis</i> *	Whistling lizard/Forest lizard
	<i>Calotes liocephalus</i> *, EN	Crestless lizard
	<i>Calotes versicolor</i>	Common garden lizard
	<i>Cophotis dumbara</i> *, /R, CR	Dumbara pigmy lizard
	<i>Ceratophora tennentii</i> *, /R, EN	Leaf nose lizard
	<i>Lyriocephalus scutatus</i> *	Lyre-head lizard/Hump snout lizard
	<i>Otocryptis wiegmanni</i> *	Sri Lankan kangaroo lizard
Gekkonidae	<i>Cnemaspis kallima</i> *	Ornate day gecko
	<i>Cyrtodactylus soba</i> *, /R, EN	Knuckles forest gecko
	<i>Gehyra mutilata</i>	Four-claw gecko
	<i>Hemidactylus parvimaculatus</i>	Spotted house gecko
	<i>Hemidactylus depressus</i> *	Kandyan gecko
	<i>Hemidactylus frenatus</i>	Common house-gecko
Scincidae	<i>Dasia haliana</i> *	Haly’s tree skink
	<i>Lankascincus deraniyagalae</i> *, EN	Deraniyagala’s lanka skink
	<i>Lankascincus taprobanensis</i> *	Smooth lanka skink
	<i>Mabuya macularia</i>	Bronze-green little skink
	<i>Chalcidoseps thwaitesii</i> *, /R, CR	Four-toe snake skink
Colubridae	<i>Ahaetulla nasuta</i>	Green vine snake
	<i>Ahaetulla pulverulenta</i>	Brown vine snake
	<i>Boiga ceylonensis</i>	Sri Lanka cat snake
	<i>Dendrelaphis caudolineolatus</i>	Gunther’s bronze back
	<i>Dendrelaphis tristis</i>	Common bronze back
	<i>Macropisthodon plumbicolor</i>	Green keelback
	<i>Oligodon sublineatus</i> *	Dumerul’s kuki snake
	<i>Ptyas mucosa</i>	Rat snake
Elapidae	<i>Calliophis haematoetron</i> *	Blood-bellied coral snake
Viperidae	<i>Hypnale</i> cf. <i>nepa</i> *	Merrem’s hump-nosed viper
	<i>Trimeresurus trigonocephalus</i> *	Green pit viper

Lankanectes cf. *corrugatus*

Lankanectes is a monotypic genus. Endemic species commonly found in the wet zone. Our data suggest the *Lankanectes* sp. observed in Knuckles is distinct from *L. corrugatus* found elsewhere; a taxonomic study is being carried out to understand its relationship within the genus. Recorded from montane and sub-montane forest habitats and commonly found in rocky-bottomed streams and water holes.

Nannophrys marmorata

Endemic, Critically Endangered species restricted to the Knuckles. Only recorded in Patana grasslands found

within sub-montane and lowland semi-evergreen forests and in moist rock crevices. There are two other species recorded in this genus: *N. ceylonensis* found in the lowland wet zone and *N. naeyakai* restricted to the Uva and eastern provinces of Sri Lanka (Fernando et al. 2007).

Pseudophilautus cavirostris

Endemic, Endangered species recorded from lowland semi-evergreen forests and Kaluganga riverine forests on tree trunks about 1.5-2 m above ground. Prefers to remain under thick, moist moss on tree trunks. Primarily found from Pallegama to Rambukoluwa (Kaluganga river bank).



Pseudophilautus cavirostris.



Pseudophilautus hankeni.



Pseudophilautus fergusonianus.



Pseudophilautus macropus.

Pseudophilautus fergusonianus

Pseudophilautus fergusonianus was recorded from lowland semi-evergreen forests in the study area. Endemic species primarily found on moist rock surfaces near streams during the day and on shrubs at night. Recorded in Walpalamulla and Rambukoluwa area.

Pseudophilautus fulvus

Endemic and Endangered species primarily found in sub-montane and lowland semi-evergreen forests. They occupy small tree holes during day and at night were observed on tree bark. Species recorded from Bambarakanda (near Walpalamulla). Only a single specimen was documented in this study.

Pseudophilautus hankeni

Pseudophilautus hankeni a recently described species (Meegaskumbura and Manamendra-Arachchi 2011); conservation status not assessed yet. Species only recorded from the Knuckles range and was previously recorded only in Dothalugala Man and Biosphere Reserve within the Knuckles conservation forest (Rajapaksha et al. 2006). Uncommon, arboreal species. Major habitat is montane forests living on mossy tree bark; occasionally recorded on ground. Documented from Kalupahana mountain range, Gomabaniya, and Yakungehela areas, expanding its previous range.

Pseudophilautus macropus

Endemic, Critically Endangered amphibian primarily found near streams in sub-montane forest habitats. Only one specimen was recorded during the study, collected on mossy bark, about 1.5 m from the ground in the Bambarakanda area.

Pseudophilautus stuarti

Endemic and Endangered species restricted to the Knuckles forest range found in understory of montane and sub-montane forest habitats, mostly in shrub layer. Recorded in Kalupahana peak, Gombaniya northern slope, and Bambarakanda.

Hylarana gracilis

Endemic species primarily recorded from riverbanks of lowland semi-evergreen forests. Ground-living species, recorded from banks of the Kaluganga Pallegama to Rambukoluwa rivers.



Pseudophilautus stuarti.



Calotes liocephalus.



Calotes liolepis.



Cophotis dumbara.

Calotes liocephalus

Endemic, Endangered, and arboreal, found in the Kalupahana peaks. Only a single specimen was documented in this study.

Calotes liolepis

Endemic arboreal species found on tree branches four m above ground in the Walpallamulla area. Agile and fast-moving.

Cophotis dumbara

Endemic and Critically Endangered species recorded from outside of the transect. Restricted to the Knuckles range; there are only a few records of this enigmatic species. First documentation of this species from Kalupahana mountain area. Only one specimen was recorded basking 1.5 m above ground.

Ceratophora tennentii

Ceratophora tennentii is an endemic, Endangered species, restricted to the Knuckles range. Species found in montane and sub-montane forest habitats. Semi-arboreal, found both on and above ground. Species recorded from Kalupahana, Bambaragala, and Gombaniya peaks.

Lyriocephalus scutatus

Endemic species with its major habitat in lowland semi-evergreen forests. Species found 1.5 m above ground, close to Yakungehela area. Display of deep red color is a defensive behavior in this species.

Cyrtodactylus soba

Endemic and Endangered species restricted to the Knuckles forest. Species recorded in montane forest habitats and rock crevices in Yakungehela peaks.

Chalcidoseps thwaitesi

Endemic and Critically Endangered species only previously recorded in a few localities in Knuckles range in lowland semi-evergreen forests. Fossorial species found under rocks in Yakungehela area.

Dasia halianus

Endemic species (Wickramasinghe et al. 2011) observed basking on tree bark in lowland semi-evergreen forests near Rambukoluwa area.



Ceratophora tennentii.



Cyrtodactylus soba.



Dasia halianus.

Calliophis haematoetron

Endemic, recently described species (Smith et al. 2008), and one of two species of coral snakes found in the country. Species recorded only from a few localities and Pallegama semi-evergreen forest. Fossorial form found on thick leaf litter layers.

Trimeresurus trigonocephalus

Endemic species exhibiting different color morphs and found in lowland semi-evergreen and sub-montane forests (plain green variation found). Nocturnal species, mostly found on bushes and in tree holes.



Lyriocephalus scutatus.



Calliophis haematoetron.

Conclusion

This survey is indicative of the importance of Knuckles range in providing refuge to a large number of amphibian and reptile species. These species are facing habitat loss, mainly due to anthropogenic activities. Forest encroachment, seasonal fires on the dry phase of the Knuckles range, illegal felling of trees, occasional gem mining, and cardamom plantations are among the threats faced by the diverse species in the Knuckles. Over several decades, the forests in the Knuckles have degraded due to cardamom planting, and to a lesser extent, by shifting cultivation and potato growing (Kariyawasam 1991). Cardamom plants thrive in shady, cool, and humid conditions at high elevations, so cardamom planters remove part of



Chalcidoseps thwaitesi.

the canopy and clear understory of the forest. These activities may be extremely detrimental to some species. In addition, similar to what is observed in the Horton Plains National Park in Sri Lanka, forest dieback also occurs in large tracts of forest in the Knuckles range. Causes of this dieback are uncertain. The resulting forest destruction and fragmentation will certainly have an adverse effect on its inhabitants. Herpetofauna in particular are extremely vulnerable to habitat changes (Pierce 1985; Wyman 1990; Blaustein et al. 1998). Furthermore, habitat loss and fragmentation due to any number of reasons will be especially detrimental to species restricted to the Knuckles. Further studies and strict conservation measures are necessary to help safeguard the herpetofauna and all the flora and fauna, that are maintaining a delicate balance in this ecosystem.

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